

**REMARKS**

Claims 1-14 are pending in this application. By this Amendment, a substitute Abstract is provided, claims 1-5 are amended, and claims 6-14 are added. Reconsideration and withdrawal of the rejections in view of the above amendments and the following remarks is respectfully requested.

**I. Formal Matters**

The Office Action objects to the disclosure for informalities in the Abstract. The informalities have been corrected by replacing the original Abstract with the attached substitute Abstract. Applicant respectfully requests that the substitute Abstract be entered and that the objection be withdrawn.

**II. Claim Rejection 35 U.S.C. § 103(a)**

**A. Figure 1**

The Office Action rejects claims 1-4 under 35 U.S.C. § 103(a) over Figure 1 of the application. This rejection is respectfully traversed.

An example of an embodiment of the subject matter set forth in claim 1 is illustrated in Figure 5 of the application. Figure 5 shows a cross-sectional view of a parts suction head, including a motor 10, a ball spline unit 20 and a rotation shaft unit 30. The motor 10 and the

ball spline unit 20 are connected by a first coupling 41. The ball spline unit 20 and the rotation shaft unit 30 are connected by a second coupling 42.

Figure 1 of the application shows a conventional suction head that includes a coupling 1 connecting a rotation central axis 11 of a motor 10 to a ball spline nut 22. However, the conventional suction head assembly does not include a second coupling that rotationally connects a lower end of the ball spline unit to the rotation shaft unit. As a result, when it is necessary to remove the rotation shaft unit for maintenance, the coupling 1 is detached from the upper end of the ball spline unit, and both the rotation shaft and the ball spline are removed. Because the ball spline unit must be removed with the rotation shaft, it is difficult or impossible to mount the ball spline unit in a rotational bearing to constrain movement of the ball spline unit.

In contrast, when a second coupling is used to attach a lower end of the ball spline unit to the rotation shaft, it is possible to remove just the rotation shaft for maintenance. In addition, because the ball spline unit does not have to be removed with the rotation shaft, the ball spline unit can be mounted in a bearing, which helps to preserve alignment of the motor, ball spline unit and rotation shaft.

The Office Action alleges “it would have been an obvious design choice to provide a second coupling means, which is similar to the first coupling means, of the prior art to transmit the rotary force of the ball spline unit to the rotation shaft.” Applicant respectfully submits that it requires the impermissible use of hindsight, in view of Applicant’s own invention to add a

second coupling to the conventional art suction head to arrive at a device as recited in claim 1.

Nothing in the prior art discloses or suggests such a combination.

For at least the reasons discussed above, it is respectfully submitted that independent claim 1 is allowable over Figure 1. Claims 2-4 are allowable for at least the same reasons as discussed above with respect to claim 1, from which they depend, as well as for their added features. Applicant respectfully requests that the rejection of claims 1-4 be withdrawn.

**B. JP 2000-091, 360, Kirby, Lee**

The Office Action rejects claims 1-4 under 35 U.S.C. § 103(a) over Japanese Publication No. 2000-091,360 (hereinafter “ '360 reference”) in view of U.S. Patent No. 4,703,965 to Lee et al (hereinafter “Lee”) or U.S. Patent No. 5,308,132 to Kirby et al (hereinafter “Kirby”). This rejection is respectfully traversed.

The Office Action alleges that the '360 reference shows a coupling means for transmitting the rotary force of the motor to the ball spline unit but does not show a second coupling means for transmitting the rotary force of the ball spline unit to the rotation shaft unit. The Office Action then alleges that Lee shows a coupling means to transmit the rotary forces between the upper shaft and the lower shaft, and Kirby also shows a coupling means to transmit the rotary forces between the upper shaft and the lower shaft having different outer diameters.

Applicant respectfully submits that the '360 reference is directed to a bonding apparatus for use in the electrical connection of a semiconductor chip and substrate. Referring to Figure

2, a bonding apparatus is shown with a lifting device 3 connected to a head unit 4. The head unit 4 drives a head section 6 of a head transport device 7.

The lifting device 3 is connected to the head unit 4 by a female thread part 21 and a ball thread 13. The female thread part 21 and ball thread 13 combination function as a lead screw for raising and lowering the head unit 4. Thus, rotation of the motor 11 causes rotation of the ball thread 13, which in turn causes the head unit 4 to be raised or lowered. The rotational force of the motor 11 is not used for any other purpose.

The head unit 4 includes a reciprocating pneumatic cylinder 19, a load cell 18, and a transfer rod 16, where the pneumatic cylinder 19 is configured to press upon the transfer rod 16 through the load cell 18.

The head transport device 7 includes support bearings 34, and a head section 6. The head section 6 includes two moveable bonding heads 26. The head transport device 7 is configured to rotate on the support bearings 34 about a vertical axis centered upon the support bearings 34. Each bonding head 26 is located 180 degrees opposite one another relative to the vertical axis, and can be rotated into alignment under the transfer rod 16.

In operation, each bonding head 26 of the head section 6 picks up a semi-conductor chip C, and rotates into position under the transfer rod 16. The transfer rod 16 is then actuated by the pneumatic cylinder 19 through the load cell 18 to lower the bonding head 26 to the substrate B to bond the chip C. Bonding is determined by the load cell 18 through measuring the force between the pneumatic cylinder 19 and the transfer rod 16.

Applicant respectfully submits that Lee is directed to an integrated circuit placement device vacuum head. Figure 2 of Lee shows a reciprocable shaft 60 actuated by an air cylinder 48 within a casing 20. The reciprocal shaft 60 is connected to a reciprocable inner tip assembly 34 by a flexible coupling 62. In operation, the air cylinder 48 extends and withdraws the inner tip assembly 34 into and out of the casing 20 through the reciprocable shaft 60 and a flexible coupling 62. The apparatus of Lee does not rotate.

Applicant respectfully submits that Kirby is directed to a circuit assembly device for programmably controlling placement force and method thereto. Figure 2 of Kirby shows a programmable end-effector 200 with a piston 202 fixed to a larger shaft 203 disposed within a cylinder 201. The larger shaft 203 is fixed to a second shaft 208 through a coupler 228, and the second shaft 208 is fixed to a tip 220. The piston 202 is configured to reciprocate linearly within the cylinder 201 to extend and retract the tip 220 for picking and placing component parts. The motion of the larger shaft 203, coupler 228, second shaft 208, and tip 220 is entirely linear. None of these items are intended to rotate.

Applicant first notes that the transfer rod 16 of the '360 reference does not rotate. Thus, the '360 reference has no need for a coupling means for transmitting a rotary force between the head unit 4 and any other portion of the '360 apparatus. Furthermore, because the motor 11 of the '360 apparatus is used to accomplish raising and lowering of the head unit, it could not also be used to selectively rotate an end effector of the '360 apparatus. Accordingly, one of skill in

the art would not have had any motivation to combine portions of the Lee or Kirby devices into the '360 apparatus.

Applicant additionally notes that coupling the pneumatic cylinder 19 to the transfer rod 16 through the coupler of Lee or Kirby, would bypass the load cell 18 of the '360 reference and render the load cell 18 inoperative. If the load cell 18 was rendered inoperative, the apparatus of the '360 reference would have no way to detect bonding, and the '360 apparatus would become inoperative for its intended purpose. Thus, the '360 reference cannot be combined with either Lee or Kirby.

Because there is no motivation to combine the '360 reference with either Lee or Kirby, and, further, any such combination would be inoperable for its intended purpose, withdrawal of the rejection of claim 1 over this combination is respectfully requested. Claims 2-4 are allowable for at least the reasons discussed above with respect to independent claim 1, from which they depended, as well as for their added features. Accordingly, the rejection of claims 1-4 should be withdrawn.

**C. JP 2000-091,360, Kirby, Lee, and Hwang**

The Office Action rejects claim 5 under 35 U.S.C. § 103(a) over the '360 reference in view of Lee or Kirby, and further in view of U.S. Patent No. 6,308,403 to Hwang (hereinafter "Hwang"). This rejection is respectfully traversed.

The Office Action refers to Figure 9 of Hwang and alleges that Hwang discloses a bearing to be provided to the ball spline nut to restrict the rotation radius of the rotation shaft. Applicant notes that Figure 9 of Hwang shows a spindle unit 40 supported by a first, second and third bearings 91, 92 and 93, respectively.

As discussed above, one of skill in the art would not have been motivated to combine the '360 reference with Lee or Kirby. Hwang does not provide any further motivation to make such a combination. Thus, withdrawal of the rejection of claim 5 is also respectfully requested.

### **CONCLUSION**

In view of the foregoing amendments and remarks, it is respectfully submitted that the application is in condition for allowance. If the Examiner believes that any additional changes would place the application in better condition for allowance, the Examiner is invited to contact the undersigned attorney, **Randall H. Cherry**, at the telephone number listed below.

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To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this, concurrent and future replies, including extension of time fees, to Deposit Account 16-0607 and please credit any excess fees to such deposit account.

Respectfully submitted,  
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Enclosure:  
Substitute Abstract

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**Amended Claims With Mark-ups to Show Changes Made**

1. (Amended) A parts suction head of a surface mount device, comprising:  
a motor configured for generating a [predetermined] rotary force and transmitting the rotatory force to a rotation central axis;  
a ball spline unit configured for performing a rotation movement and a vertical reciprocation movement by the rotary force generated from the motor;  
a rotation shaft unit comprising a rotation shaft, wherein the rotation shaft unit is configured to be moved in a vertical direction and rotated[,] for sucking or mounting [a] parts;  
and  
a plurality of couplings configured [coupling means] for transmitting the rotary force of the rotation central axis [of the motor] to the ball spline unit[,], and for transmitting a [the] rotary force of the ball spline unit to the rotation shaft unit.
2. (Amended) The parts suction head of [a surface mount device according to] claim 1, wherein the plurality of couplings comprise [coupling means comprises]:  
a first coupling configured for connecting the rotation central axis of the motor to a first [one] end portion of the ball spline unit; and  
a second coupling configured for connecting a second [the other] end portion of the ball spline unit to the rotation shaft unit.

3. (Amended) The parts suction head of [a surface mount device according to] claim 2, wherein a first end portion of the ball spline unit comprises a ball spline nut and [when the rotation central axis of the motor and the ball spline nut of the ball spline unit are inserted,] the first coupling [for transmitting the rotary force of the motor to the rotation shaft] is connected between the rotation central axis of the motor and the ball spline nut to maintain a predetermined distance [(m)] m between the rotation central axis and the ball spline nut.

4. (Amended) The parts suction head of [a surface mount device according to] claim 2, wherein [when the other end portion of the ball spline of the ball spline unit and the rotation shaft of the rotation shaft unit are inserted,] the second coupling is configured [connected] to maintain a predetermined distance [(m)] m between the second end of the ball spline unit and the rotation shaft unit.

5. (Amended) The parts suction head of [a surface mount device according to] claim 1, further comprising [wherein] a bearing fixed [is provided] to the ball spline nut and configured to restrict a rotation radius of the rotation shaft unit [receiving the rotary force].